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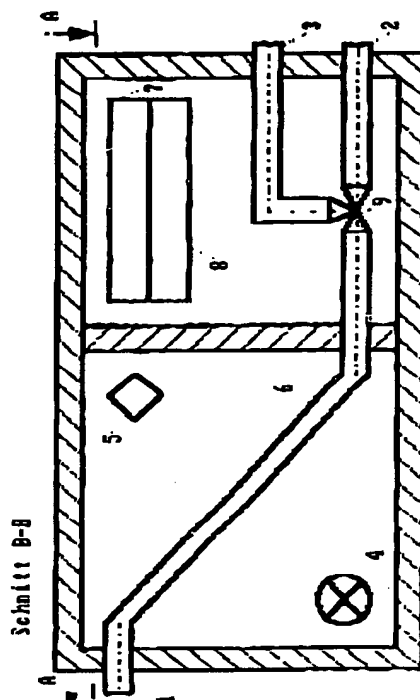
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(54) Verfahren und Vorrichtung zur optoelektronischen Erfassung der Eutergesundheit und der Milchqualität

(55) Eutergesundheitskontrolle; Milch; Schadmerkmale;  
optischer Sensor; Auswertung nach Methoden der  
Merkmalsextraktion; Aussonderung mastitisgeschädigter  
und verschmutzter Milch

(57) Die Erfindung beinhaltet ein Verfahren und eine  
Vorrichtung zur optoelektronischen Erfassung der  
Eutergesundheit und der Milchqualität. Die Erfindung  
betrifft ein Verfahren und eine Vorrichtung zur  
automatischen Eutergesundheitskontrolle mit dem Ziel,  
verschiedene Schadmerkmale von Milch wie Flocken, Eiter,  
Gerinnsel, Schmutz, Blut und Schleim mit einem optischen  
Sensor zu erfassen und dem Melker Informationen über die  
Eutergesundheit zu geben. Die aufgenommene  
Bildinformation wird nach Methoden der  
Merkmalsextraktion ausgewertet, so daß  
mastitisgeschädigte und verschmutzte Milch ausgesondert  
werden kann, bevor sie mit Milch anderer Kühe in  
Verbindung kommt. Fig. 1



## Method and device for optoelectronic detection of udder health and milk quality

### 5 Abstract

Udder health control; milk, damage characteristics; optic sensor; analysis according to methods of extraction of characteristics; discarding of mastitis-damaged and polluted milk.

10 The invention includes a method and a device for optoelectronic detection of udder health and milk quality. The invention relates to a method and a device for automatic udder health control with the purpose of detecting various damage characteristics in milk such as flocks, matter, clotted substances, dirt, blood and slime with an optic sensor and supply the milker with information of the udder health. The detected im-  
15 age information is analysed according to methods of characteristics extraction, so that mastitis damaged and polluted milk can be discarded before getting in contact with milk from other cows. Fig. 1.

### Claims

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1. Method for optoelectronic detection of udder health and milk quality, wherein a control device is placed in the milking stream when milking, wherein the milk is carried over a lit area where by using optic sensors (5), the optically recognisable characteristics of the udder secretion are  
25 detected, the optical condition of the area in image form is transmitted to an analysis unit (7), the area image is compared to optically recognisable unchanged milk, recognisable changes in the milk such as lumps, flocks, clotted substances, dirt, blood, colour changes and others are detected through methods of extraction of characteristics, de-  
30 tected changes through control signals are transmitted to the separation device (8), changed udder secretion is indicated to the milker, and necessary valves (9) are set, so that mastitis-damaged and polluted milk is removed from the tubing system of the allowed milk and carried over to other containers through separate systems and that the part of

2

the tubing system that has been used for the changed udder secretion is cleaned and disinfected before being used again.

- 5           2.       Device for optoelectronic detection of udder health and milk quality, wherein after connection of the milk inflow system (1) the milk is running over a broadened measurement section (6) in the tubing, wherein a light source (4) is placed so that the available optic sensor (5) is detecting the optically recognisable udder secretion in the area of the measurement section (6), which is transferred as an electrical signal in image form to the analysis unit (7) so that the constructively placed valve (9) is automatically set to flow milk inflow system (1) – outlet system "changed raw milk" (3) in the case of changed udder secretion characteristics, and to milk inflow system (1) – outlet system "quality raw milk" (2) in the case of unchanged udder secretion characteristics.

- 15           3.       Device for optoelectronic detection of udder health and milk quality according to claim 2, wherein all parts of the device for reasons of protection against outside light intrusion are placed in a box.

20       **Field of use of the invention**

The invention relates to a method and a device for automatic milk inspection. Optically recognisable changes from the normal udder secretion characteristics with respect to colour, texture and additives that are caused by a mastitis disease are thereby recognised. Changed udder secretion is also discarded. This method and device is applicable in milk production and processing companies, where milk has to be checked for the above-mentioned changes. The automatic determination of important quality parameters of the milk is a precondition for use of automatic milk withdrawal.

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**Characteristics of the state of the art**

Up until now the udder health and milk quality has been assessed in the production process by manpower. TGL 22 257 (milking) prescribes that at the beginning of milking a premilking (2-3 squirts) from every quarter of udder has to be milked by

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## 3

hand onto a black test plate. The milker assesses this premilking test for visually recognisable changes from normal udder secretion characteristics and decides whether this milk can be used or has to be discarded. It is tested whether there are solid particles in the milk such as protein clots, dirt and blood or flocklike, bloody, inflamed, watery-slimy or other changes.

Some technical solutions which can be used at this stage of the technological process are already known. They are mainly based on physical test methods.

Mechanical test- and separation methods are mainly based on the use of filters or strainers. The removal of formations from the milk by means of filters and the various technical solutions for the automatic control of the degree of filter pollution as a measure of the milk quality (mastitis status) are known as further technical solutions from among others US-PS 4385590 and DD-PS 221625 .

Through electric methods it is possible to detect the mastitis status and thereby the milk quality indirectly. Through the temperature and the electric conductivity a test device in accordance with DE-PS 2334069 determines the quality of the milk during the milking process. In various solutions the conductivity measures are also carried out through squirting on the test plate.

Further solutions are using optical methods for detection of udder health and milk quality. A continuous density measuring device which detects the changes of reflection, refraction and dispersion in the milk through a photodiode, is described in DD-PS 134893.

The method and the device given in US-PS 4190020 and DD-PS 135271 for extraction of blood-free and protein-free milk and milk low in germs seem to be the most suitable to fit directly into the technological process. Through examination of the transmission degree there will be a detection of the lack of quality.

Disadvantages of all known methods and devices are e.g.:

- Mechanical methods only permit removal of solid components in the milk. Udder secretion changed in another way is not removed;
- The inaccuracy that is caused by the various influences on the conductivity makes the use of electrical conductivity measurements unfavourable;
- The optical methods do not permit any structure or texture analysis. A detection of colour changes, texture and additives cannot be carried out as only a change of the transmission of the milk is measured;
- The known solutions are technically not adequately reliable and practical for premilking tests in production conditions;

4

- With use of electrical and mechanical methods an increase in the cleaning and disinfection expenditure is necessary, so that it is not yet possible to leave out man in this part of the production process.

## 5 Purpose of the invention

The purpose of the invention is to create a method and a device for automatic detection and discarding of milk that shows changes from the normal udder secretion characteristics with respect to colour, texture and additives. It will be possible to detect optically recognisable changes in the udder secretion and to direct the milk to an appropriate use.

## Detailed description of the invention

15 The purpose of the method and the device of the invention is to automatically detect changes from the normal udder secretion characteristics of the milk and to release an adjustable signal to a device for discarding of such optically recognisable changed milk.

As udder diseases normally result in a change of the udder secretion, the diseased animals have to be recognised, the milker must be informed and their milk must be collected separately.

In accordance with the invention the purpose is achieved when at the time of milking a testing device is placed in the milking stream and the milk is carried over a lit detection area. An optical sensor detects the optically recognisable characteristics of the udder secretion. These are packed in image form as information regarding the optical condition of the detection area and carried on to an analysis unit wherein the area image is compared to the unchanged milk. This is followed by an examination for the presence of changed udder secretion in the actual area. Through an, in accordance with known technical solutions, internally carried out analysis of structure, texture, average grey scale value and difference in grey scale value between adjacent image points of the detected area, lumps, flocks, clotted substances, dirt, blood, colour changes and other optically recognisable changes are detected in the milk.

If changes to the normal udder secretion are found, the milked milk is discarded. To achieve this, an adjustable signal is given to a separation device. Valves are set that

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will discard the changed milk away from the tubing system of the allowed milk. If necessary the milk will be diverted to a collecting container through separate tubes and directed to a use that is in accordance with its changed udder secretion. If the examined udder secretion is, according to its characteristics, found to be normal then a drive towards the separation device will follow. In accordance with the applied milk extraction method the milk will then be carried to the collecting container. For implementation of the method it is necessary to have a device with the below described technical construction.

The parts of the device are placed in a box for protection against outside light intrusion. The inspection device is placed in the transport tubing of the milk between the milk inflow system and the outlet system of the quality raw milk.

A separate tubing system is attached to the outlet system "changed raw milk".

In the milk inflow system there is a broadened measurement section in the tubing between a light source and an optical sensor.

The signal given from the optical sensor is forwarded to the analysis unit. The image analysis can be carried out with the use of software by a micro computer or a corresponding hardware structure.

When there is a detection of unchanged udder secretion an adjustable signal is forwarded through to the separation device.

The valve is then set to the flow milk inflow system – outlet system – "quality raw milk". As long as there is changed udder secretion the valve is set to flow milk inflow system – outlet system – "changed raw milk".

### Example

The invention is explained below through an example. The drawings show:

Fig. 1 Sectional view B-B of the milk inspection device

Fig. 2 Sectional view A-A of the milk inspection device.

After connection of the milk inflow system 1, the milk flows over the measurement section 6. Here a lighting will take place using the light source 4. The optical sensor 5 detects the udder secretion characteristics in the area of the measurement section 6 in image form. This information is detected as an electric signal in the analysis unit 7. Through an image analysis, the udder secretion is examined for characteristics,

6

such as lumps, colour changes, clotted substances, dirt, blood and others. If no changes to the characteristic udder secretion are recognised, the valve 9 is set by the separation device 8. The flow is directed to the outlet system "quality raw milk" 2. If udder secretion interferences are recognised the further progress will take place through the outlet system "changed raw milk" 3. The valve 9 stays in a neutral position. The parts of the device are placed in a box for protection against outside light intrusion.

5

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